The R&D Edge

US Army Corps of Engineers®
Engineer Research and Development Center

Research and Development for Sustainable Military Installations

Winter 2008

MILITARY CONSTRUCTION

COBIE Captures Building Data from the Source to Serve Operating and Asset Management Life-Cycle Needs

By Dana Finney

In the Directorate of Public Works (DPW) at Fort America, you're working on next year's budget when the telephone rings. It's the non-commissioned officer-in-charge at building 3892, which houses classrooms for computer training. Room 11A is hot. The air-conditioner is running, but no air is flowing through. You suspect a fan malfunction.

Still seated at your desk, you tap in the building number and your computer displays a wiring diagram of the training facility, complete with the as-built scoop on fans. You click on the fan that serves room 11A and instantly, you have all of the information you need – location, tag number, manufacturer, warranty terms, service records, parts list, and the ability to automatically produce a work order. You press a button. The work order is automatically routed to the closest technician with the right expertise, tools, and materials to do the work. You return to your budget.

This is the DPW's dream, and it is about to be realized, thanks to a new standard called Construction Operations Building Information Exchange (COBIE). Part of the National Building Information Modeling Standard (NBIMS), COBIE is being pilot-tested at Fort Lewis, Wash., as a means to capture building information while it is produced during the facility delivery process. It will then be turned over to the building operator, who can use it for both maintenance and asset reporting functions.

"Think about a computer file with a '.txt' ending," said Dr. Bill East, researcher at the Engineer Research and Development Center (ERDC) who led the national effort to create COBIE. "No one cares how it got to be that kind of file – only that if you want to open it with any word processing program, you can. COBIE will do the same thing for files that contain facility information. Our goal is to make the construction-to-operations hand-off just as transparent."

The Corps is the design and construction agent for all military construction (MILCON) projects in the Army and Air Force. At each step in the facility delivery process, experts generate information about a building which is ultimately lost as the project evolves. When the facility is ready for turnover to the customer, various systems must go through a validation, or "commissioning," process, during which the constructor is required to collect information that will comprise the operation and maintenance (O&M) manuals. This requirement typically is met via a "job-crawl" by experienced construction contractors. The result is an unwieldy stack, or even a room full, of paper documents that, to be useful, must be manually keyed into various management and reporting systems.

As part of MILCON Transformation, starting in fiscal year 2008, contractors will be required to use BIM and COBIE will be included in the model template as an optional deliverable.

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Ironically, all of the information needed to operate and maintain a building, and to meet Department of Defense (DoD) and Army real property inventory requirements, had already been created upstream in the planning and design phases. So to pay the builder to recreate it, and then pay someone else to transcribe it, the facility owner ends up paying for the information several times with no final guarantee of accuracy or completeness.

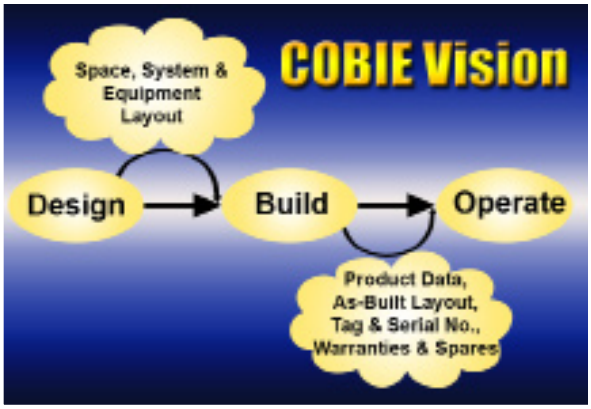
According to Jerry Harbison, master planner for the Installation Management Command (IMCOM) Western Region, "I like to compare what COBIE will do to a football game, which people can relate to. The Corps is the quarterback and wants to pass data to support a modern data environment, while the DPWs are the receivers who want to catch the data, but it takes practice and training – you aren't going to score a touchdown immediately."

COBIE is part of a much bigger chain of events happening within the architectural, engineering, and construction (AEC) community. Indeed the explosive development of new tools and business process innovations today often seems like the proverbial runaway train. But instead of leaving all the decisions up to large software vendors who will provide what they think will sell their products, multiple government and industry players are harnessing the momentum to clearly identify end-user requirements so as to effect a positive change in the way buildings are conceived, built, and managed throughout their life cycles.

The COBIE standard is one of the initial family of data exchange protocols fielded under NBIMS, led by the National Institute of Building Sciences (NIBS). The bigger picture is building information modeling (BIM), which is an emerging technology that will use NBIMS to enable open interchange among computer tools for the AEC industry, along with front-end, life-cycle data capture.

The Corps of Engineers announced its intent to transition to BIM-enabled business processes in March 2006. A memorandum signed by Maj. Gen. Merdith W.B. ("Bo") Temple, Director of Military Programs, directed the Corps' eight Centers of Standardization (COS) to realign and to submit plans for implementing BIM, initially for selected facility types within their responsible areas. "This way ahead will make us more effective providers of technical services while helping us maintain our core technical competencies," Temple wrote. All Corps Districts will implement BIM under a phased approach.

BIM produces a building model that represents both physical and functional attributes of a facility, allowing all AEC project participants to communicate using this single reference point. The model includes everything from architectural, structural, piping, HVAC, and other macro-scale systems to an individual room's furniture and color schemes.



COBIE is the O&M piece of BIM. The concept is not new – many DPWs have sought access to documents produced early in the planning and design phases, but the facility delivery process has not been conducive to handing off information from one phase to another, nor from one participant to another.

"Why didn't anyone think of this before?" East said. "We did, but there was no framework to solve the problem in a way that everyone could benefit. NBIMS provides that framework so that information will be captured in a consistent format as it is created and automatically uploaded into multiple types of databases." He noted that a full BIM rendering will not be necessary for DPWs to use the modeled data – only the simple wire diagram.

At Fort Lewis, the DPW team had reinvented its business processes to beneficially use building data in its adopted commercial work management system, MAXIMO. Lyle Fogg, the DPW's computer engineer, explained that "One of the reasons we became involved in COBIE is that we had been starting to pull in building information electronically and import it into MAXIMO. We had mapped out a business process, in the beginning, just for our local contracts, where we were focusing on how to get information about the project before it was complete. Then we could use it in MAXIMO for preventive maintenance scheduling as a clock that you just turned on and were alerted when work needed to be done. We mapped this in a way that could eventually move up to our MCA [Military Construction, Army] contracts."

COBIE fits into Fort Lewis' revamped business process because it allows data capture in a format easily transferable to MAXIMO and most other computer-aided maintenance management systems (CMMS). That format currently is an Excel spreadsheet.

"The concept is simple. COBIE tells us what data we need and in what format, and it's all on the spreadsheet which becomes the common denominator for all of the parties involved in facility delivery and management – the designer A/E, contractor, Corps, and DPW," said Harbison. "It also crosses the functional boundaries of real property accounting and engineering."

"The information contained in COBIE includes operations, maintenance and asset management information. COBIE is fully compatible with the Real Property Inventory Requirement [RPIR] and could allow the full

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CERL Receives Patent for New Self-Healing Coating

By Cynthia Greenwood

ERDC's Construction Engineering Research Laboratory (CERL) has developed a new coating that repairs itself when it is damaged. Besides lowering maintenance costs for the Department of Defense (DoD), the technology makes life safer for Army personnel and their families.

The U.S. government awarded a patent to the Army in March 2007 for the version of the technology now used on steel structures. "We see a widespread application of this coating on any steel structure, including automobiles, bridges, oil rigs and platforms, and outdoor air-conditioning units," said Dr. Ashok Kumar, a program manager at CERL and one of the technology inventors. Kumar noted that Vinod Agarwala, a Navy materials expert, originally started developing a similar self-healing coating technology to protect aluminum alloy exteriors on aircraft.

The product has an unusual ability to heal itself immediately after being dinged, cut, or otherwise damaged. It consists of a liquid coating with microcapsules containing specific repair formulations that allow the coating to fix itself immediately after it is compromised in any way. "If something bangs against the coating and cuts it, the pressure will cut open the microcapsules and cause them to release liquids—known as 'film formers'—and restore the cut area," said Dr. Dave Stephenson, a materials expert at CERL and co-inventor. "At the same time, the microcapsules also release a corrosion inhibitor, which prevents corrosion, while the restored coating is curing."

For steel structures, the applicator can take a commercially available paint primer and mix it with a prespecified amount of the microcapsules. After the coating has cured, any physical damage to the cured coating will trigger the microcapsules to burst and release a liquid that "fills and seals the compromised volume of the coating," according to the U.S. Patent abstract. For other applications, engineers must purchase microcapsules that are custom-designed to work well for their specific paint formulation.

Lead-based paint poses a serious health risk to residents on Army bases, particularly children. In some situations it is more practical and safer to "overcoat" deteriorating paint rather than scrape off the existing coating.

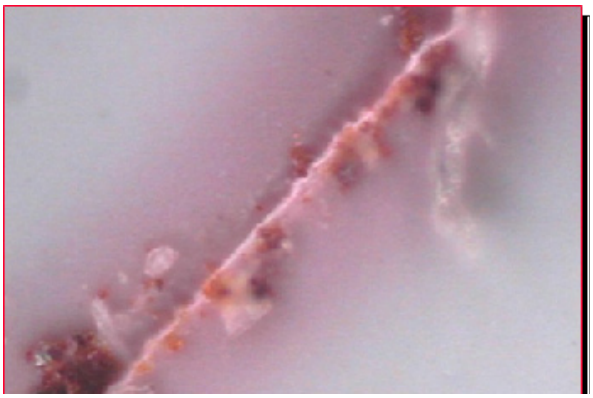
"When a crack occurs in lead-based paint and its overcoating, the self-healing overcoating will heal itself as the liquid inside the microcapsules flows into the damaged area," said Stephenson. "The microcapsules also release a lead dust suppression compound that prevents hazardous lead dust from becoming airborne, while the film former cures over the damaged portion."

The new technology will prove especially useful for maintaining wooden Army installation houses covered in lead-based paint. In a 2003 laboratory experiment, CERL researchers compared the benefits of a self-healing overcoat and a plain latex overcoat. They applied both materials on a wooden building covered in lead-based paint at Fort Ord, Marina, Calif., a former Army base. The self-healing overcoatings revealed a 95 percent reduction in lead dust over the controls in the lab. The patent for the lead-based paint version of the technology will be awarded in late 2008.

For more information on the self-healing coatings or any other corrosion mitigation technology, please contact Dr. Ashok Kumar, ERDC-CERL, 217-373-7235, Ashok.Kumar@erdc.usace.army.mil

Editor's note: The original version of this article appeared in the Summer 2007 issue of ***CorrDefense*** *at www.corrdefense.org.*

This deluge tank at Fort Campbell, Ky., has benefited from CERL's patented self-healing coating system.



Above: Microcscopic view: microcapsules are broken and release coating healant and corrosion inhibitors when the coating is damaged.

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automation of the DD 1354 form," said East.

Starting with all FY08 MILCON Transformation solicitations, the Corps will include a requirement for contractors to provide COBIE data at the end of the project. "This will mean that data capture must move upstream, to the planning and design phases," East said. In fact, this change in business could spur a new cottage industry of experts who provide the service of early information capture, more or less replacing the job crawl in which contractors can only document components they can physically see after construction is complete.

The most exciting thing about COBIE and the other NBIMS initiatives is that their timing is perfect for being rolled up in the development of the Army's General Fund Enterprise Business System – GFEBS. The foundation of GFEBS is open data exchange, which will ultimately allow the Army to be vendor-neutral. The entire facility delivery process will be managed in GFEBS, as will the O&M cycle of every facility and the asset management reporting requirements under Executive Order 13327.

To make these changes happen, all of the players involved in building design, construction, O&M, reporting, and disposal must be fully engaged – possibly for the first time ever. "It's a critical point in time for everyone to start working together," said Fogg, who also serves as the O&M representative on the GFEBS development team. "It's real important that people start a dialog and keep talking about it, even though the implementation may be in fits and starts. We have this unique opportunity to get it right."

Harbison concurs. "If we want to synchronize COBIE with GFEBS, it's critical to support funding stream for development to move COBIE from research to full deployment Army-wide. For the first time, all of the players, all these professionals who speak a different language, will be able to communicate as a result of these data exchange standards."

Fogg added, "The whole concept of COBIE is not a genie you can put back into the bottle." ■

Electrolyzer Lab Goes Online at CERL

A new test facility at ERDC's Champaign, Ill., site uses a proton exchange membrane (PEM) water electrolyzer to produce hydrogen gas as part of ongoing research into fuel cell technology. Manufactured by Distributed Energy Systems, this unit is the only 10-cell, high-pressure electrolyzer currently in existence. Using a water supply and electricity from the local grid, it "electrolyzes" water, meaning it splits H_20 into hydrogen and oxygen. The hydrogen gas is captured and stored in six compressed H_2 gas cylinders.

High-pressure electrolyzer located inside the new lab at Champaign, Ill.

Since the early 1990s CERL has managed full-scale demonstrations of emerging fuel cell technology for the Defense Department. While the focus has mainly been to investigate fuel cells for onsite power generation at military installations, interest in other applications has been growing

Current technology can electrochemically produce electricity much like a conventional battery by using the H_2 component from natural gas, propane, and anaerobic digester gas. Fuel cells operate quietly and with greatly reduced emissions compared to reciprocating engine generators. They could represent one of several technology options for providing energy security to DoD.

CERL received funding for the electrolyzer from the Tank Automotive Research, Development, and Engineering Command (TARDEC). Housed in a newly built laboratory, it produces 10 standard cubic feet of H_2 per hour at a pressure of 2,200 pounds per square inch. Its ability to produce H_2 at such high pressure eliminates the need for mechanical compression and increases overall efficiency.

The stored hydrogen gas runs a new Plug Power GenCore™ PEM fuel cell (5 kilowatt, 48 volts direct current), also recently installed at the site. The electricity produced by the fuel cell feeds a load bank that dissipates the energy to provide supplemental heat for the building.

CERL will field-test the electrolyzer in various modes of operation for 1 year. "The intent it to run the equipment to ground so that we can see how it performs," said researcher Scott Lux. "We will also be looking at total efficiencies."

As part of the test, the system will be evaluated for base camp operation via Silent Camp™ conditions, where power is supplied by low-noise and low-impact methods. Compared to standard diesel generators normally used at base camps, this system would have lower sound emissions, less environmental impact, and potentially reduced fuel requirements.

For more information, contact Frank Holcomb at CERL, 217-373-5864, Franklin.H.Holcomb@erdc.usace.army.mil. Visit our website at http://dodfuelcell.cecer.army.mil. ■

CASI Completes First Year as Sustainability Expert Hub

By William D. Goran

In late 2006 ERDC launched a center that serves as an enabler to link multiple agencies involved in delivering sustainable technology and practices for military installations. The Center for the Advancement of Sustainability Innovations (CASI) unites expertise at the ERDC labs with numerous university, commercial, and other government partners to help achieve goals stated within the Army's Strategy for the Environment – Sustain the Mission, Secure the Future.

Located at ERDC's Construction Engineering Research Laboratory (CERL) in Champaign, Ill., CASI completed its first year of operation with some $1.5 million in project funds. The initial focus has been on developing partnerships and selecting robust teams to collaborate on eight focus areas:

- Anticipating future issues and opportunities
- Sustainability approaches, measures and knowledge management
- Sustainable regional planning
- Sustainable energy solutions
- Sustainable facilities and infrastructure
- Sustainable water resources
- Ecosystem services and natural capital
- Sustainable forward military operations

Projects have been initiated in each focus area. Generally, teams in each area work with proponents on "white paper concepts" for more sustainable operations. These concepts may lead to a study and/or a workshop in which multiple stakeholders participate, but the goal of these efforts are to forge a common understanding of the "way forward" with sustainable support to the military mission, to protect and preserve resources, and to engage and support communities. Following are some examples of CASI's activities during its first year.

Sustainable Water Resources

Water concerns, including adequate water supply, increased cost of production per unit volume, water quality, habitat degradation, and salinity issues are already impacting military installations and military operations in many locations. A new Army environmental research requirement identifies water "reuse" as a priority to address water supply and water cost increases; it also cites examples where water supply, water price and/or water quality are currently impacting U.S. military bases.

During 2007, a CASI team drafted a white paper on water supply for military bases and potential technologies to help stretch available water use. The paper recommends several comprehensive actions by military stakeholders to better understand, anticipate, and address emerging water supply and water quality challenges. The premise is that employing new approaches to water management and conservation, augmented by new technologies, will enable military stakeholders to reduce the cost of water supplies to installations, sustain mission activities, and avoid possible "water-limiting" scenarios where communities and bases "compete" for water resources. Through regional coordination partnerships, like the SouthEast Regional Partnership for Planning and Sustainability, installations can also influence surrounding communities to adopt similar water reuse approaches.

Sustainable Forward Military Operations

The U.S. military conducts contingency operations that include humanitarian assistance, logistics activities, and stability and reconstruction missions. Sustainability has become an increasingly important concept in these operations. Sustainable operations are a force multiplier through increased efficiencies, reduced logistical burdens, and reduced costs.

CASI is helping the Army develop short-, mid-, and long-term strategies, structured along a timeline, for sustainable full spectrum operations. The goal is to develop a roadmap tying different initiatives into a strategy to better use limited resources, including reuse of wastes. Life-cycle and material flow analysis of emerging technologies and solutions will help shed light on the most effective technologies and approaches to implement for forward operations.

Forward military operations must plan for environmental issues such as handling wastewater when local facilities are either inadequate or unavailable.

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Sustainable "Neighborhoods"

A CASI team has been active in helping the Army and other Defense services "build green" through the application of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) and other tools. Before CASI was formed, an ERDC team helped the Army make the decision to adopt the LEED Silver standard for all new construction. Now CASI teams are helping evaluate the use of sustainability standards for historic buildings and the use of new LEED standards – such as those for homes, new work on existing buildings, and an emerging standard for "neighborhoods."

A project is planned for 2008 to examine the implications of this "neighborhoods" standard, which evaluates how a complex of buildings (such as a new neighborhood) accommodates multiple transportation modes, allows for the movement of water in watersheds, impacts species habitats, and affects other "location" criteria, as well as the energy use and sustainable design characteristics of buildings in the neighborhood. The military services and their partners build many new complexes and neighborhoods, so this LEED standard, or some similar criteria, could have far reaching impacts on how they do cantonment-wide planning.

The Way Forward for CASI

CASI is working closely with the Army Sustainability Council, the Army Environmental Policy Institute, and a new Corps of Engineers Sustainability Council to coordinate and review projects, and to plan forums to present concepts. In many cases, CASI is also helping to "connect" efforts already underway, in different programs, to improve the dialogue and coordination across these programs.

For FY08, CASI has added two technology focus areas: (1) Sustainable materials and (2) Climate change impacts on agency facilities and missions. For more information, please contact William Goran at CERL, 217-373-6735, William.D.Goran@erdc.usace.army.mil ■

ERDC Offers Free Water Treatment Course

A free three-day course on water treatment for DoD facilities will be held in New Orleans on 12-14 March 2008, just before the NACE Corrosion 2008 Meeting, March 16-20. This course is sponsored by the DoD Corrosion Policy and Oversight Office. There is no tuition cost to DoD registrants, and ERDC will fund the travel costs for attendees from Army installations.

This course is designed for Water Facility Engineers and Technicians who work for DoD. The goal of this course to deliver the guidance necessary to help military installations be "smart users" of water treatment for new and existing heating and cooling, and potable water systems.

Registration information is available from Susan Drozdz, ERDC 217-373-6767, or susan.a.drozdz@us.army.mil. There are only 31 seats available in this course, so act now to secure your place! ■

Army Mandates Use of Management Systems for M&R Planning

A new Army Regulation, 420-1, which became effective on Dec. 2, 2007, requires the use of ERDC-CERL products PAVER, RAILER and the ROOFER component of BUILDER to be used by U.S. Army installations to manage maintenance and repair (M&R) for pavement, rail and roof infrastructure. A consolidation of several previous regulations, along with changes, AR 420-1 also specifies that the Army will also continue to depend on ERDC's Geotechnical and Structures Lab to support the federally mandated Bridge and Dam Inspection Programs.

PAVER, RAILER, and ROOFER are part of CERL's family of Sustainability Management Systems (SMS). They are based on condition index ratings derived from inspection and allow facility managers to (1) develop and organize an inventory; (2) assess current condition; (3) develop models to predict future condition; (4) report on past and future performance; and (5) develop scenarios for M&R based on budget or condition requirements.

For more information, contact Lance Marrano, 217-373-4465, Lance.R.Marrano@erdc.usace.army.mil. ■

The R&D Edge

This bulletin is published to communicate ERDC's research and development activities in the Environmental Quality and Installations (EQ/I) business area. **Dr. Ilker Adiguzel** is the business area director; **Dr. John Cullinane** is the lead technical director. Editor: Dana Finney, 217-373-6714. Visit our website at: ***http://www.erdc.usace.army.mil***